Physician-Directed Software Design: The Role of Utilization Statistics and User Input in Enhancing HELP Results Review Capabilities

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ABSTRACT

The M.D. Rounds Report program was developed and implemented in June of 1992 as an adjunct to the HELP System at Rex Hospital. The program facilitates rapid access to information on allergies and current medications, laboratory results, radiology reports and therapist notes for a list of patients without physicians having to make additional menu or submenu selections. In planning for an upgrade of the program, utilization statistics and user feedback provided valuable information in terms of frequency of access, features used and unused, and the value of the program as a reporting tool in comparison to other online results reporting applications. A brief description of the functionality of the M.D. Rounds Report, evaluation of the program audit trail and user feedback, planned enhancements to the program, and a discussion of the prototyping and monitoring experience and the impact on future physician subsystem development will be presented.

INTRODUCTION

Staff physicians at Rex Hospital have had the capability of reviewing clinical information online since 1988. The Physician Subsystem, developed at Rex, is an extension of the 3M commercial version of the HELP System developed by Warner and associates [1]. The Subsystem allows physicians to review and/or print patient lists, laboratory results, procedure reports, therapist notes, medication lists, and demographic and insurance information at Rex or at their offices or homes. However, according to a medical staff survey conducted in 1990, only 34% of those responding used the Subsystem frequently, and another 42% never used the Subsystem. Negative respondents felt that the Subsystem was difficult to use due to inconsistent functionality of the menu options and the excessive number of steps required to access the desired information, making data retrieval a tedious and time-consuming process.

In response to these complaints, the HIS Clinical Systems Research department developed and implemented the M.D. Rounds Report program in June of 1992 with the goal of improving the user interface and providing rapid access to a variety of patient data [2]. The program, which had undergone several cycles of prototyping and revision as well as pilot testing by a small group of physicians, generates customized reports for a list of patients without the physician having to make additional menu or submenu selections. The patient list may consist of all patients for which the user is the attending M.D. or patients selected individually by means of a patient identification screen. Users may specify: 1) screen review and/or print, 2) a 24-hour report, a single data category report with results posted within up to the last 98 days (e.g. radiology results for the last 14 days), or a customized report based on a user-created format, and 3) reverse chronological or chronological data presentation. The 24-hour report (all test results posted within the last 24 hours) displays the following data in a fixed arbitrary order: allergies, current medications, drug alerts, chemistry, urinalysis, serology, hematology, microbiology, drug levels, blood bank, Same Day Surgery labs, ABGs, radiology reports, and respiratory care notes.The customized report, based on individual physician preferences, may display one or more data categories in any order with the results being posted within the last one to five days. Reports can be viewed in a scrolling window which the user can page through at leisure, and "Print Screen" capability is available to users with PCs connected to "slave" printers.

In anticipation of future upgrading of the M.D. Rounds Report program, an audit trail had been built into the program which provides information on the frequency and patterns of physician usage. This was

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done in order to supplement information to be obtained through user surveys which, while helpful and indeed essential, do not provide sufficient detail on program usage and acceptability. Moreover, the physician response rate at Rex is typically low, making it difficult to generalize the opinions of a small group of users to all users. The built-in audit trail is unique among all Physician Subsystem programs. Although an audit program has monitored Physician Subsystem usage for several years, the program was designed primarily to identify physicians who failed to log off the Subsystem, blocking access to shared remote ports. Therefore, data is restricted to terminals accessed at remote sites or in the physician lounges, only main menu selections are logged, and only the number of accesses and the length of time associated with each access is recorded. The failure to record Subsystem usage at terminals located on site other than the physician lounges, as well as the number of patients for which data was reviewed, makes it difficult to compare definitive usage rates between programs. However, this information can provide some general insight into the types of online data retrieval performed by physicians at Rex.

Table 1. Profile of Physician Users By Specialty.

Specialty	Specialists	% Staff	Users	% Specialists	% Staff	% Users
Internal Medicine	52	8.2	20	38.5	3.2	18.9
Obstetrics-Gynecology	52	8.2	12	23.1	1.9	11.3
Pediatrics	69	10.9	8	11.6	1.3	7.5
General Surgery	24	3.8	7	29.2	1.1	6.6
Orthopedic	27	4.3	7	25.9	1.1	6.6
Hematology/Oncology	12	1.9	7	58.3	1.1	6.6
Cardiology	30	4.7	7	23.3	1.1	6.6
Family Practice	37	5.9	6	16.2	0.9	5.7
Anesthesiology	14	2.2	5	35.7	0.8	4.7
Gastroenterology	19	3.0	4	21.1	0.6	3.8
Gynecology	7	1.1	3	42.9	0.5	2.8
Cardiovascular/Thoracic	13	2.1	3	23.1	0.5	2.8
Pulmonary	6	0.9	3	50.0	0.5	2.8
Infectious Disease	5	0.8	3	60.0	0.5	2.8
Nephrology	11	1.7	2	18.2	0.3	1.9
Otolaryngology	17	2.7	2	11.8	0.3	1.9
Plastic Surgery	9	1.4	1	11.1	0.2	0.9
Urology	12	1.9	1	8.3	0.2	0.9
Ophthalmology	22	3.5	1	4.5	0.2	0.9
Neurology	11	1.7	1	9.1	0.2	0.9
Radiation Oncology	4	0.6	1	25.0	0.2	0.9
Pathology	6	0.9	1	16.7	0.2	0.9
Emergency Medicine	10	1.6	1	10.0	0.2	0.9
Total	469	74.2	106	22.6	16.8	100.0

Table 2. Profile of Physician Users By Training Session Attendance and By Report Volume.

Specialty	Users	Trained	Reports	% Reports	Reports/User
Infectious Disease	3	0	960	35.7	320
Hematology/Oncology	7	1	483	17.9	69
Nephrology	2	0	253	9.4	126
Cardiovascular/Thoracic	3	1	221	8.2	74
Anesthesiology	5	3	140	5.2	28
Internal Medicine	20	5	136	5.1	7
Other	66	21	499	19.5	8
Total	106	31	2692	100.0	25

Table 3. User Survey Results.

Program Feature	Very Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Very Dissatisfied	No Opinion
Ease of Use	4	3	2	0	0
Data Provided	8	1	0	0	0
Data Completeness	5	3	1	0	0
Data Ordering	5	4	0	0	0
Report Format	7	2	0	0	0
Screen Format	6	3	0	0	0
Overall Satisfaction	4	4	1	0	0
Total	39	20	4	0	0

Table 4. Cumulative Results of Physician Subsystem Audit (Remote and Physician Lounge Terminals Only).

Program	# Accesses	Average # Users Per Month	% Staff
Results Review	1656	50	7.9
Radiology Review	1344	32	5.1
M.D. Rounds Report	295	16	2.5
Patient Medication Profile	65	6	0.9
Abnormal Lab Results	40	3	0.5
RHS Review	10	1	0.2
Respiratory Care Module	7	1	0.2
Drug Alert Report	6	1	0.2
Patient List By M.D.	2622	34	5.4
M.D. Patient List	1186	29	4.6
Total	7231	99	15.7

AUDIT TRAIL AND SURVEY ANALYSIS

Approximately nine months (270 days) of post-implementation data were collected and analyzed. 106 physicians (16.8% of the 632 total medical staff), representing 23 specialties, have used the M.D. Rounds Report program during that period. Internal medicine and obstetrics-gynecology comprise the largest user subgroups, and the specialties with the highest percentage of users include infectious disease, hematology/oncology, pulmonary, gynecology, internal medicine and anesthesiology (Table 1). These 106 physicians generated reports on 2,692 patients, averaging 10 reports per day ("report" refers to an individual patient report). 61.7% of these reports were customized, and 93.4% presented data in reverse chronological order. 46.5% of the reports were screen display only, 26.2% were printed, and 28.3% were both screen display and printed. No single data category reports were generated. On an individual basis, physicians preferred to use the same report on a regular basis, whether 24-hour or customized.

Physician users can be identified as either high-volume or low-volume users based on the number of reports generated during the audit period. 37.7% were high volume users (those generating over 130 reports), with internal medicine and hematology/oncology comprising the largest user subgroups (Table 2). Infectious disease and hematology/oncology specialists generated the largest number of reports. Overall, high-volume users generated 81.5% of the reports, averaging 55 reports per user, and 67.2% of these reports were customized. In contrast, low-volume users averaged 8 reports per user, and 62.7% of these reports were 24-hour. There was no correlation between the number of users and the number of reports for any given specialty.

25% of all users created 42 customized report formats (one to six per physician). The number of data categories per format ranged from one to twelve with an average of five. The most commonly included data categories were hematology, chemistry, microbiology and radiology. Infectious disease specialists created the most formats (13).

31 users (4.9% of the total medical staff) had been formally trained to use the program (Table 2). This group constituted 48.4% of all physicians who had received training (10.1% of the total medical staff) but only 29.2% of all users. The remaining 75 users had not received any formal training. There was no correlation between training and the number of reports generated.

A program survey was distributed randomly to 100 physicians during departmental staff meetings. Only 16 physicians responded, of which seven had never used the program. The nine users (8.5% of all users) rated the program favorably overall (Table 3).

The Physician Subsystem results reporting programs most frequently accessed from remote and physician lounge terminals are Results Review and Radiology Review, with the M.D. Rounds Report a distant third (Table 4). Among all Subsystem programs, the two patient list programs together are those most frequently used by physicians. On average, only 99 physicians (15.7% of the total medical staff) use the Subsystem on a monthly basis.

PHYSICIAN COMMENTS

Preliminary comments made during pre-implementation training sessions indicated physicians felt the M.D. Rounds Report program offered greatly improved user-friendliness and functionality over the current result reporting applications. Some felt they now had a reason to use the HELP System and requested HELP access.

Physicians submitted requests for program enhancements which included the following: 1) default report settings, 2) report format editing and deleting capability, 3) expanded patient list capabilities, including selection of patients in the physician's attending, associate and/or consulting capacities, the ability to maintain their own patient lists, and the ability to run reports for one or more patients selected from the list, 4) the ability to return directly to the patient list after report generation and run off different reports for different patients, 5) the capability to set data review periods longer than 5 days, 6) revamping of the printed report format to save paper, and 7) a reduction in the number of selection screens.

EVALUATION OF RESULTS

The audit trail demonstrates that all report capabilities of the M.D. Rounds Report program were used with the exception of the single data category report, which will be deleted from the upgraded program. Less than 10% of the physician users prefer chronological data presentation, suggesting that reverse chronological presentation should be the default. No conclusions can be made regarding the report mode (screen display or print) as physician offices currently do not have remote printing capability. The high percentage of untrained users suggests that the program is very user-friendly and that many users learned about the program through word of mouth from other physicians.

The program has achieved limited success as a niche application for a small group of users who are primarily consultants and prefer to obtain a comprehensive summary of patient test results. This outcome was unanticipated since few of these users were trained and none were involved in the prototyping phase of development. On the other hand, the program has failed to attract users away from the more cumbersome results reporting programs. Few physicians use the program on a daily basis, and the Physician Subsystem audit reveals that it is not the program of choice for accessing clinical information. This may be due to the repetitive cycle of selection screens for report settings and the necessity of building a patient list every time the program is accessed, which the user may view as being nonadvantageous. Also, it is speculated that physicians who are only interested in one data category such as radiology or chemistry prefer to use review programs other than the M.D. Rounds Report, which would also retrieve data that may not be of interest at the time of inquiry or may be already known to the physician. This may be the reason why internal medicine practitioners, who follow patients closely on a daily basis, use the program less frequently.

The Abnormal Lab Results, Drug Alert Report and Respiratory Care programs available on the Physician Subsystem were not accessed during the last several months of the audit. These programs are known to have been used infrequently in the past. Feedback from physician users is needed in order to provide insight regarding program preferences.

PROGRAM UPGRADE DESCRIPTION

The physician enhancement requests discussed previously have been incorporated into the upgraded program. Based on additional feedback from the nine physicians currently piloting the upgraded program, the capability to select all results or abnormal results only will also be available in the final version which will be implemented in September of 1993.

The upgraded M.D. Rounds Report program will have a new interface based on pull-down menus. The physician's patient list will be retrieved, and the physician can maintain default report settings in which the patient list type, report format, results type, display mode and data presentation chronology are specified. These settings can be changed during program execution enabling different reports to be generated for any subset of patients. Report settings and formats can be viewed within pop-up windows. The patient list can be printed, and physicians can add or delete patients for which they are consulting. Recording of the patient list type, patient registration number, terminal location and patient transaction type will be added to the audit trail. Both the HIS Physicians Committee and the group of piloting physicians have been active in the development process and have responded positively to the program changes.

DISCUSSION

The M.D. Rounds Report program has demonstrated that there exists a diversity of needs among practicing physicians for online clinical information retrieval and display capabilities. Past medical staff surveys at Rex indicated that simplification and standardization of the user interface is of high priority. These factors have had a major influence on program design and development, which in turn has stimulated program usage and constructive critiquing for a small but well-defined group of staff physicians. An unanticipated user benefit of the demand for incorporating patient list capabilities into the program will be a significant improvement in the response time for patient list retrieval due to the development of a separate patient list file and subsequent simplification of the retrieval algorithm. Inclusion of default report settings and a pull-down menu interface should increase program usage and broaden the user base, ideally extending to current nonusers.

The impact of the M.D. Rounds Report program on the structure of the Physician Subsystem is still under evaluation. The Subsystem currently consists of 22 applications. Four have redundant functionality, and eight are infrequently used. HIS Clinical Systems Research is continuing to monitor the monthly Subsystem audit in order to identify applications that could be eliminated. The Patient List By M.D., M.D. Patient List, Abnormal Lab Results and Drug Alert Report programs may become candidates for elimination since the M.D. Rounds Report program will assume their functionality.

The experience of prototyping, implementing and monitoring utilization of the M.D. Rounds Report program has affirmed several of the application design principles identified by Zibrak et al. [3]: 1) minimize typing in favor of selection from lists, 2) have no requirement for formal training in order to use the system, 3) develop a function perceived to be indispensable that will encourage daily usage and trials of other system functions, and 4) involve physicians in the development process. It has also concurred with the usability methods of prototyping cycles, user involvement in design and testing, obtaining user feedback and logging user system activity presented by Nielsen [4]. In contrast to the reports on user-centered design methods reviewed by Fafchamps et al. [5], we have not found direct user involvement in the program design process to be a negative experience.

The HELP Doctor's Advisory Council, comprised of physicians at academic and commercial HELP sites, is collaborating in the development of a new HELP physician module that incorporates intra- and inter-departmental data viewing capabilities, intelligent alerts and alarms, user-defined reports and flow sheets, and ease-of-use features in order to facilitate physician interaction with HELP. The M.D. Rounds Report program is one of several applications influencing the design of this new module which will provide to physicians not only basic results review capabilities but also important decision support tools.

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